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ON A NEW METHOD
OF
CLOSING BLEEDING BLOOD-VESSELS

BY

MOVEABLE FORCEPS.

BY

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[*Reprinted from the BRITISH MEDICAL JOURNAL, October 12th, 1867.*]



PRINTED BY
T. RICHARDS, 37, GREAT QUEEN STREET.

MDCCCLXVII.

ON A NEW METHOD OF CLOSING BLEEDING BLOOD-VESSELS BY MOVEABLE FORCEPS.

WHATEVER opinion may be entertained of the value of acupressure in arresting hæmorrhage from divided blood-vessels, as compared with the use of ligatures, no one, I apprehend, can for a moment doubt that, if some method of safely arresting the flow of blood could be devised, which would not necessitate the retention within the wound of any foreign substance, a great improvement in operative surgery would be effected; or, failing this, any plan which should securely seal the wounded or divided blood-vessel, and allow the wounded parts to be brought together without the presence of a foreign substance, or, if this be necessary, would ensure that its presence should be innocuous, and that it should be capable of removal without the wound being in any way disturbed, or its healing by the first intention prevented—would be an advance of no inconsiderable importance. Without in any degree endorsing the exaggerated statements as to the dangerous—even deadly—effect of fibrous ligatures in wounds, there is no practical surgeon who will not be ready to acknowledge how great would be his satisfaction in being able to do without them, if he could only see his way to do so safely. Hence the alacrity which so many surgeons have shewn in adopting acupressure, which, if we were to accept the statements of some writers, we should believe to offer a means so satisfactory as to be incapable of improvement; while, on the other hand, if we are guided by the opinions of others, it is a practice fraught with great risk, and is only a dangerous snare and a visionary delusion, well enough for the amateur in his study, but unworthy of the surgeon at the operating-table. That the method may be adopted in many cases, with the effect of arresting hæmorrhage from divided blood-vessels, even of large size, is certain, from the cases reported in which it has been practised; and that, in many instances where it has been adopted, the wounds have healed up rapidly and well—appears to be true; but the practical question is, not whether this may be done in some cases, but whether, as a rule, the practice is a safe one, and is followed by better results than where an ordinary ligature has been employed. I confess to feeling great doubts upon this question; and I believe the great majority of operating surgeons will agree with me in this opinion. I have taken every possible means of arriving at an accurate conclusion; and the result is to confirm the doubts I have felt, both on theoretical and practical grounds. I have purposely visited Aberdeen, where certainly acupressure has been practised with more zeal, and probably to a greater extent, than anywhere else. I have inquired at other and larger hospitals where it has been tried and abandoned, and I have seen it used many times at our own Infirmary at Leeds, without being able to say that, on the whole, I have had reported to me, or have witnessed such results, as to convince me of its value and superiority over the old-fashioned ligature, or to induce me to give up the thread for the needle. The difficulties of effectually closing the blood-vessel, temporarily and permanently, are so great as, in my judgment, to counterbalance the undoubtedly great advantage of

having the wound free from the long continued presence of a foreign substance. Though Drs. Pirrie and Keith assure me that in their hands no case of hæmorrhage, either primary or secondary, has happened; and that all, even large amputations, have not only recovered, but have healed by the first intention, without sloughing, pyæmia, crysipelas, or other misadventure; the results have been far different in other hospitals and in other hands, where some of the stumps have not only had to be opened out to more effectually secure bleeding vessels (which, it might perhaps be asserted, happened to be so by the want of skill or care on the part of the operator), but where the withdrawal of the pins has been followed by hæmorrhage so copious as to prove that no permanent closure of the vessel had been effected; while union by the first intention, which is the great desideratum, has not only not been obtained, but as much suppuration and delay in healing by granulation has taken place, as in the ordinary method; gangrene of the stump has occurred, and pyæmia and erysipelas have been set up. I must confess to my experience more nearly corresponding with the latter results, than with those of Drs. Pirrie, Fiddes, and Keith. I, therefore, infer that the great success which, I am assured, has been experienced in Aberdeen, is dependent upon some other influence than acupressure alone; indeed, I cannot but feel too much is proved by the reported enormous success, which is too great to arise solely from the employment of acupressure. However advantageous it may be, it alone could not exempt large operations from danger, and ensure uniform recovery. Some other accidental, overlooked, and unknown, but most potent influences, must have been at work. As there are seasons of great want of success, in which, from one cause or other, often so subtle as to be unknown, almost all wounds, however unimportant, do badly, so there are other times when all, however serious, do well. I cannot but suppose that at least part of the Aberdeen success must be attributed to such a condition rather than to the use of acupressure alone.

Immediately after Sir James Simpson's introduction of acupressure, I had correspondence with him on the subject; and he has favoured me with letters from time to time since then; so that my attention has been constantly directed to the subject. My first idea was that, if the fibrous material were the cause of the pyæmia and other calamities, as Sir J. Simpson has emphatically declared, the use of metallic ligatures would at once obviate the mischief; and as animal bodies are more tolerant perhaps of iron than of any other of the metals, I got iron wire drawn of various degrees of fineness, even up to what was presumed to be No. 45 (for no gauge is made nearly so fine), and, by careful annealing, managed to obtain it as flexible as common thread or silk, without rendering it brittle, so that it will draw into a double knot as easily as they will. With this, in amputations, I tied many blood-vessels. In two cases of amputation of the thigh, the femoral arteries were secured by the wire; I found it to cut well through the inner arterial coats, and to hold firmly; but, while it thus proved effective as a ligature, I did not perceive any material advantage in the healing of the wounds, and it was accompanied by a very important disadvantage, for the very property of being so tolerated by the system without exciting irritation, which gives the metal so great a superiority over fibrous material for sutures, is attended by a corresponding disadvantage where it is used as a ligature on vessels; for, instead of separating within the usual period required for the coming away of thread-ligatures, the iron-ligatures would remain on for an indefinite period. Some of them I was obliged to cut off as close as I could and leave on the vessel, so that a complete cure was unduly delayed; and I have almost given up the plan in consequence.

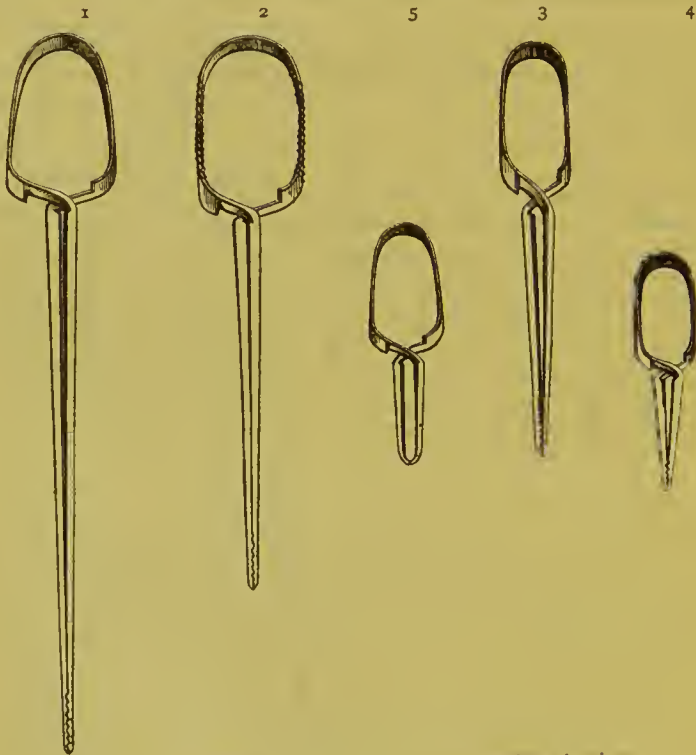
More recently it has suggested itself to me that, if I could contrive self-acting forceps sufficiently fine in the stem not to keep open the wounded parts, sufficiently strong to keep the divided vessel perfectly closed, and yet not so powerful as, by their pressure, to cause sloughing or ulceration of the included vessel, but merely adhesion of its coats and closure of its mouth, firm enough to remain securely on the part to which they are applied, and yet capable of being withdrawn at any desired period without in any way disturbing the wound, or interrupting the desired union by the first intention, the hæmostatic power wanted would be obtained.

After a trial of various forms, I think that I have succeeded in devising a form which will supply all the required essentials. I need not detail the different forms of compressing power which I have tried, nor the defects of one kind or other that I have found in them; but simply give a sketch of that one which, after sufficient trial, I have found to answer. As the vessels lie at different depths from the surface and are of different sizes, the forceps must be of different lengths and strengths. Obviously, to reach and hold the femoral artery, a larger and stronger instrument must be employed than that which is required to compress a cutaneous or subcutaneous branch, and so for vessels of intermediate size and position; but, I think, four, or at most five, sizes, will be found sufficient for all purposes. They should range from three inches to three-quarters or half-an-inch long. While the latter will be adapted for small superficial vessels, the larger will be large enough for the femoral or iliac arteries, even in stout men. The points of the forceps should just embrace the vessel, while the bowed shoulder should just project out of the wound; a greater length would be useless and inconvenient by being in the way, while it is necessary that the bow should project from the skin, or it will keep the lips of the wound apart, and not allow of the forceps being readily removed from the vessels, and so, in the attempt to do this, possibly, by disturbance of the vessel, cause hæmorrhage, or arrest the healing process in the wound. The forceps are self-holding; to remove them, it is only necessary to press upon the bow. This may be made broad, rather flattened at the sides, and, if desired, somewhat roughed, so as to afford a firmer hold; while the blades should be made as fine, and lie as close together, as is compatible with the necessary strength. This, however, need not be great, for very little power is necessary to effectually close the mouths of even large arteries, provided it is only uniform and regular in application; a certain strength is more requisite for giving firmness and stability to the forceps than for making great pressure on the blood-vessels. The points of the blades should be roughened, as in the ordinary dissecting forceps, so that they may hold better. I had at first small teeth made so as to seize the vessel, but this I find to be unnecessary in ordinary cases; but perhaps, where a large number of vessels have to be secured, and much handling and disturbance of a stump is required before all is made safe, the small teeth would cause the forceps to be less liable to be displaced while this is going on. So soon as the surfaces are brought together, there can be no danger of disturbance. Hitherto I have had them made of steel by a cutler, which, of course, is somewhat costly at the first; but as they can, after well washing, be used any number of times, this really is not a consideration, and if they had a thin deposit of gold upon them all fear of rust, etc., would be removed. I am by no means sure that, for the short time the forceps remain on the vessel, steel is necessary; I think it probable that manufacturers of the safety-pin, or like handicraft workmen, may be able to supply a forceps sufficient for all purposes at so small a price, as to allow it to be used without any consideration of economy.

This I am taking steps to ascertain. At one time I thought of employing forceps whose blades are brought together by a screw motion or by a sliding tube; the latter idea had also occurred to Mr. Birkett, as he told me the other day when we accidentally met on a steamboat on Loch Lomond; but, like him, I abandoned it, for I found it had disadvantages, and, moreover, would be very costly. Doubtless other forms will suggest themselves to other persons, and modifications may be made; whatever may most effectually secure the requisites I have named will be so much gained.

From small arteries I have removed the forceps in from twelve to twenty-four hours, but, in the larger, twenty-four to forty-eight hours should be allowed to elapse before they are taken away, by which time, I apprehend, the largest artery may be regarded as effectually sealed, though, if thought requisite, I see no reason why they may not be left *in situ* for a longer period. Hitherto all the cases in which the forceps have been employed have done remarkably well, but a longer time and more experience will be required before we can dogmatise upon how much is due to the employment of the forceps, and how much to other circumstances.

I think it by no means improbable that, in some cases of aneurism, compression, by similar forceps, of the artery, on some point of its course above the sac, for a greater or less length of time, may be successful. The sheath of the vessels should be merely punctured to an extent sufficient to allow of the forceps being glided upon the artery alone, no other part being included or disturbed. If, after a sufficient trial of the



Figs. 1, 2, 3, 4.—Different sizes of forceps, with roughened points.
Fig. 5.—Forceps with toothed extremities.

forceps on divided vessels, I find the result as satisfactory as I anticipate, I shall certainly feel disposed to use them on an aneurismal artery.

I would just add another word. After the wound is properly brought together, the forceps are very much less likely to be disturbed in the necessary or accidental movements of a patient than are the needles in acupuncture; that no other tissue than the vessel itself is compressed, as it necessarily is in that process; and that, if venous hæmorrhage be troublesome, there is no reason why the forceps should not be applied to the open vein as well as to a bleeding artery, for the effects would not be like those to be feared from a ligature, and the forceps may be removed on the completion of the operation or very shortly afterwards.

I append a sketch of the forceps, and their different sizes, which sufficiently explains their construction, only pointing out that the compressing power is obtained by the cross joint, as in the little bull-dog forceps of Liston; and, if more power be desired than the simple bow gives, any amount of pressure may be obtained by giving it a second or third turn, and making the turns larger, but this I apprehend will not often be required. To make security doubly sure: if any one feels any doubt as to all fear of hæmorrhage being removed by giving the forceps one or two turns after seizing the vessels and bringing them out of the wound, he will combine torsion with pressure.

As I have heard fears expressed lest the long legs of the forceps should give way, and allow the open vessel to escape and hæmorrhage to occur—a fear, however, in which, if the forceps are properly constructed and applied, I do not participate—I have had another form of forceps made. These are shewn in fig. 6. They are fine forceps, with long straight



Fig. 6.—Forceps with compressing clip: 1, a moveable clip, having a slot which slides upon 2, a projection of the rivet, which unites the two blades; 3, a roughened button upon the top of the clip; and 4, a fixed one upon the opposite side of the forceps, by which these can be more easily held, and the clip pushed down towards the points of the forceps.

blades, on the upper part of which is a sliding clip, which is to be pressed down so soon as the vessel is seized by the points. By this arrangement, any amount of pressure may be applied, and slipping is impossible. The clip in those shewn in the figure is kept steady by a slot, which slides upon a projecting part of the rivet which unites the two blades; but I think this slot may be done away with, and the clip made simply to slide upon the two blades, by which arrangement there would be less chance of the forceps becoming fixed in the wound by the coagulated blood.

